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How might the gender roles affect the implementation of a new water-saving technique for Colombian rice production?

Report of gender dimensions in Colombian rice production

CIAT Working Paper

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CIAT Publication No. 437
December 2016

García MA; Katto MC; Twyman J; LaHue G; Chirinda N. 2016. How might the gender roles affect the implementation of a new water-saving technique for Colombian rice production? Report of gender dimensions in Colombian rice production. Working Paper. CIAT Publication No. 437. International Center for Tropical Agriculture (CIAT), Cali, Colombia. 37 p. Available at: http://hdl.handle.net/10568/81594

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Summary

Globally, rice cultivation is responsible for 10% of greenhouse gas emissions released by agricultural activities. To sustainably reduce the contribution of rice to greenhouse gas (GHG) emissions, it is important to pursue management and technological options that reduce emissions and improve farmer productivity, adaptation and resilience to climate change impacts. Alternate wetting and drying (AWD) is a water-saving technique that helps farmers adapt to less water availability. It reduces the amount of in-field gas emissions associated with rice production, and it may increase and/or maintain rice productivity levels. The International Center for Tropical Agriculture (CIAT) and partners are conducting several studies to evaluate the feasibility of implementing this technology in Colombia, a country that has committed to reducing economy-wide GHG emissions by 20% under the 2015 Paris Agreement and implementing adaptation plans by 2030. The sustainable implementation of AWD requires an understanding of the economic, climatic, political, agronomic and social considerations within which farmers operate. The literature shows how gender roles can influence the adoption of a technology or be affected by the introduction of a new technology. A baseline study was designed to answer the following questions: how might gender impact the adoption of AWD in Colombia? And how will the adoption of AWD affect the gender division of labor? A household survey with sex-disaggregated information in 609 households in five departments was conducted. The results suggest that women own rice assets and make decisions about production but are not recognized as rice producers. They do not receive agricultural information and do not have group membership in the same proportion as men do. Furthermore, households in which women participate as producers are more likely to have noneconomic incentives and water availability (i.e. no problems with water scarcity) to implement AWD. Women participate in manual weed control as hired labor and men participate more in irrigation, and both activities can be affected by the implementation of AWD. For AWD to be widely implemented in Colombia, it is important to target women as well as men and create awareness of the possible social effects of the technology in gendered labor activities, and therefore in the lives of both women and men.

Key words: decision making, labor, alternate wetting and drying, gender, rice, Colombia.

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Introduction

Colombia has contributed to, and is part of, the solution towards overcoming climate change challenges. This country, according to 2010 calculations, is among 40 countries that had the greatest contribution to greenhouse gas (GHG) emissions between 1990 and 2012 (García et al., 2015). Because of its geographic location, it is vulnerable to climate variability. In this context, during the United Nations Conference on Climate Change in Paris 2015 (COP21), Colombia committed to reducing GHG emissions by 20% and increasing adaptive capacity by implementing at least ten adaptation initiatives by 2030. The agricultural sector represents 19% of GHG emissions, which highlights the need for the design and implementation of technologies, practices and programs to mitigate GHG emissions in the agricultural sector while supporting farmers to adapt to climate variability (García et al., 2015).

Annually, rice contributes approximately 500 million tonnes (t) of GHG emissions globally. This represents 10% of GHG emissions from the agricultural sector (Adhya et al., 2014). Consequently, the International Rice Research Institute (IRRI) designed and promoted a climate-smart agricultural (CSA) technology known as alternate wetting and drying (AWD), which is an improved water-saving technique that reduces methane gas emissions by approximately 48% and water use by 30% (Richards and Sander, 2014). This means that during the crop cycle, there will be times when the plot is flooded and times when it is drained (with sufficient soil moisture that doesn't impact yields), contrary to permanent flooding, the most popular practice for irrigated rice.

But for CSA technologies to be designed, disseminated and adopted in a specific context, it is important to understand the different trade-offs and consider the various dimensions. These include climatic, agronomic (current crop management), economic (cost and benefits of implementing the technology), political (infrastructure and policies) and social considerations. The social and economic dimensions require an understanding of aspects such as: the particular actors at the household level that decide on whether to implement a new practice or technology; the resources needed and their accessibility and availability; and the possible socioeconomic effects that a new technology could have on people's lives (i.e. a reduction/increase in labor and/or the generated benefits). Understanding differences and dynamics between women and men in terms of decision making could help us to understand how gender differences could influence the adoption of a CSA technology and how the implementation of the technology could affect the gender division of labor.

Historically, the introduction of agricultural technologies has focused on best practices, but these generally lack a gender focus that explores whether the technologies are accessible to both men and women and if it is likely to have differentiated effects on women and men (World Bank et al., 2015). Currently, there is more concern in the global agenda about understanding the relationship between gender and CSA practices, especially as gender

could constrain or enable the successful adoption of promising technologies. Any unfavorable effects that promising technologies may have on women and men need to be identified and addressed to optimize the technology.

Organizations and studies have shown that new technologies could be more successful if women's and men's needs and preferences are taken into consideration (Huyer et al., 2015). Gender is important in mitigation and adaptation strategies: "not only are marginalized [women] the first and worst affected by extreme weather events, but they also possess local ecological, social and political knowledge which can inform and contribute significantly to climate change adaptation strategies" (Figueiredo and Perkins, 2013: 188). This means, that the differences between women's and men's constraints, incentives, resources, thoughts, responsibilities, and preferences, could positively or negatively influence the adoption of a CSA technology.

The introduction of technologies can also increase or decrease the time spent in an agricultural activity, which might impact men and women differently, if they perform specific activities on the farm. Labor-saving technologies can be positive or negative, depending on one's perspective. A wage laborer would experience a labor-saving technology as a reduction in labor time and thus wages, which is typically interpreted as a negative impact. An unpaid laborer, will see labor-saving technologies that free up more of their time for leisure or other activities as a positive impact (Bishop-Sambrook 2003; Doss 2001; World Bank et al., 2015). For example, the introduction of a mechanical thresher in Bangladesh had an unfavorable effect on poor women because it replaced the work they were performing in the rice fields as hired laborers (Beuchelt and Badstue, 2013). But a new technology can also reduce the time spent on activities allocated to unpaid family labor, such as in the case of Flexi-biogas, which provides cooking gas for smallholders who keep livestock, and that at the same time saves 2 to 3 hours of women's time in cooking, time that can be used for other income-generating or leisure activities (World Bank et al., 2015).

The case of AWD and gender

Previous analyses on the adoption of AWD in Asian countries have found that socioeconomic variables can limit or enable farmers in using this technology. For example, the following variables have been found to affect the farmer's adoption of the technology: economic incentives in reducing water use (e.g. water cost, pumping, labor and inputs); institutional support or infrastructure; contact with extension services; water scarcity; when the rice crop area is larger than the non-rice crop area; land type (e.g. leveled land); control of water; and education level of the household head (Adhya et al., 2014; Lampayan et al., 2015; Rahman and Bulbul, 2015).

Previous studies have indicated how gender aspects could be related to the implementation of AWD (Adhya et al., 2014; Farnworth, 2015). An evaluation in the Mekong Delta, Vietnam, found that in rice production, women are typically overlooked by extension services, despite their contribution because rice production is viewed as being primarily a male domain. This issue is reflected by low institutional awareness of gender in rural projects and in AWD+ training programmers (i.e. a technological package which includes AWD, rice varieties, crop establishment, and pest management options) targeting farmers (Farnworth, 2015). In the same study, Farnworth (2015) shows that there are clear economic benefits when AWD+ projects target women and enable their participation in rice production; the total costs of production are significantly reduced and profitability increases. Women, who are key actors in rice production, are not recognized and this may slow down the adoption rate and successful implementation of AWD. Therefore, the introduction of AWD will need to consider the needs, preferences and constraints of these important, yet often ignored actors (i.e. women) to increase the probability of success.

Gendered labor aspects were identified as an important research domain for AWD in Asia: "On average, women provide nearly half of the labor input in Asia's rice producing areas, so they may stand to benefit from improvements in water management" (Adhya et al., 2014). AWD is likely to lead to further time savings for women smallholders, and more loss of work for hired labor (Farnworth, 2015). The introduction of AWD could affect the time spent on specific activities, such as irrigation and/or weed control, and therefore the lives of those who perform it.

For rice production in Latin America, there are some indicators of gender roles and differences in rice production. Women's participation is often unrecognized and their contributions as decision makers are not usually recognized, in part due to cultural bias that defines women as having mainly domestic duties such

as caring and cooking and men having productive responsibilities such as rice production (Twyman et al., 2015a). Although women are not usually recognized as rice producers, a study in Peru found that women participate in transplanting (Muriel, 2013) and in Bolivia in manual activities related to weed control (Twyman et al., 2015a). Nevertheless, women are less likely to have access to extension services, agricultural information and key agricultural resources (e.g. large-size land, inputs and labor) (Muriel, 2013).

To date, information about gender roles and differences between women and men in rice production is lacking in Colombia. Therefore, the International Center for Tropical Agriculture (CIAT), in collaboration with the CGIAR research program on Climate Change, Agriculture and Food Security (CCAFS) and the National Rice Federation in Colombia (FEDEARROZ), conducted a socioeconomic baseline study with a gender perspective that aimed to evaluate the feasibility of implementing AWD. The project was supported by the Climate and Clean Air Coalition (CCAC).

The study sought to find out how gender might impact the adoption of AWD in Colombia. We had two key hypotheses: women participate in decision-making processes and will influence AWD implementation on their farms; and compared to men, women have less access to incentives and resources necessary to implement AWD (e.g. water level, grounding technology, etc.).

We also aimed to discover how the adoption of AWD would affect the gender division of labor on-farm. We hypothesized that since women do much of the manual labor (e.g. manual weed control), this may affect the implementation of AWD. AWD may increase weed pressure if it is not well managed. The recommendation is to start doing the wetting and drying cycles after canopying so that the weeds are starved of light and do not grow as much. We envisage that, in production systems in which women participate as hired labor, if the number of person days used for weed control are reduced due to AWD implementation, this would imply less work opportunities for women and less income for these households. On the other hand, if women worked as family laborers, lower weed pressure may imply more time is available for other activities related to income generation or leisure.

By addressing these questions, we tried to create awareness of the possible gender constraints that could affect the future implementation of AWD and of the possible social effects of AWD in the lives of women and men involved in rice production. This document contains a descriptive analysis for each question. First there is a general characterization of the households interviewed. Then, there is an analysis of women's participation as decision makers and a description of the gender differences in access to resources for AWD. Afterwards, we present a description of the possible effects of AWD on the gendered division of labor. Finally, there are concluding remarks and recommendations for next steps for a second phase of the project.

1. Methodology

A representative farm household survey was implemented in five departments in Colombia, which represent the major rice production zones in the country: Tolima, Norte de Santander, Córdoba, Cesar and Casanare. Interviews were conducted in 609 households who grow irrigated rice, in during March and April 2016. The sample is representative of rice farm-households in the five departments. The sample was determined through a two-stage procedure based on the Colombian Rice Census data set of 2006, provided by FEDEARROZ. The sample was limited to those households with irrigated rice located in municipalities with five or more cases, for a population of 5,597 cases with irrigated rice. The number of communities to be sampled in each department was calculated based on the National Rice Census. Then, we randomly selected households to participate, based on a list provided by locals in the communities.

During the fieldwork two problems arose that did not allow us to include the desired number of observations. First, due to accessibility challenges, it was impossible to accomplish all the surveys in Córdoba and at first some observations of the population were not taken into consideration in the sampling procedure in Tolima and Norte de Santander. To overcome these issues, an expansion factor process was applied, which allowed the surveys to be representative of the real population (Tables 1 and 2).

Table 1: Sample distribution with expansion factor.

Department	HH Interviewed	
	#	%
Tolima	435	71.4
Norte de Santander	106	17.4
Cesar	21	3.4
Córdoba	31	5.1
Casanare	17	2.7
Total	609	100

Source: Authors calculations from Gender/AWD survey, 2016.

Table 2: Distribution of the population.

Department	Population	
	#	%
Tolima	3996	71.4
Norte de Santander	972	17.4
Cesar	189	3.4
Córdoba	287	5.1
Casanare	153	2.7
Total	5597	100

Source: Authors calculations from rice census (FEDEARROZ 2006).

A six-module questionnaire was used to collect information on the demography of the household members; characteristics of the house and assets; agricultural land owned and production levels; water management; production and irrigation problems; sources of information; and participation in agricultural organizations or associations. The questionnaire was based on previous studies of adoption of modern varieties developed by CIAT and on an operationalization of the research objectives. A pilot test was conducted with women and men rice producers in Jamundí, in the department of Valle del Cauca, with the support of Arroz Blanquita, a rice miller. Finally, the survey was implemented in tablets using the Census and Survey Processing System (CSPro).

The survey contained sex-disaggregated information about women's and men's participation in the decision-making process, labor, ownership of assets and land, participation in agricultural/social groups and access to information about rice production and water management. In all cases, the interviewed person was a household member who participated in decision making about rice production, either a woman or a man.

Collected information was mainly from men's perspective, since in just 9% of the cases the respondent was a woman. The minimum standards for sex-disaggregated data recommend capturing information from men and women at the individual level to identify gender differences within the household – either by conducting intra-household surveys that interview both a man and a woman in each household or by interviewing a minimum number of women respondents to allow for statistical analysis for differences between men and women respondents (Doss and Kieran, 2013). But in this case, it was not possible due to the limited resources available, and it was not possible to interview more women, because in the field they often do not see themselves as producers or decision makers, a fact that has been presented in previous studies (Twyman et al., 2015a). Nonetheless, the information available from this study allowed us to conduct a gender analysis of questions asked about men's and women's roles, access to resources, and participation in decision making, although the results were based primarily on men's perspectives as they were the most respondents (91% compared to 9% of women respondents).

A group of 5 coordinators and 18 enumerators conducted the survey under the supervision of CIAT researchers. This group participated in a four-day training workshop in either Tolima or Cesar. The training workshop included practical visits to rice farmers (with plots in municipalities outside the sample) to pilot the questionnaire and address challenges and concerns identified by the enumerators and coordinators.

Training of enumerators in Cesar.

2. Characterization of rice households interviewed

The surveyed households surveyed had specific social, economic, and production characteristics. Most rice-producing households were headed by men with a partner (72% of cases) and had on average three members. The highest education level attained by one of the members did not exceed secondary education (i.e. high school) in 67% of the households. There were a significant number of households (33%) where at least one member was enrolled in or had attained higher education (undergraduate and graduate studies). And on average, respondents had worked in rice cultivation for approximately 23 years.

To measure poverty, the Progress out of Poverty Index (PPI) developed by Grameen Foundation for Colombia was used. This measure calculates the probability of being under the poverty line using a set of 10 questions/variables. The set of variables add up to a total score ranging from 0 to 100. The closer a household is to 0, the more likely it is to be under the poverty line. According to the results, most households had high scores, which means they had a low probability of being below the poverty line (Figure 1). The average score was 52, which means a probability of only 9% of being below the poverty line.

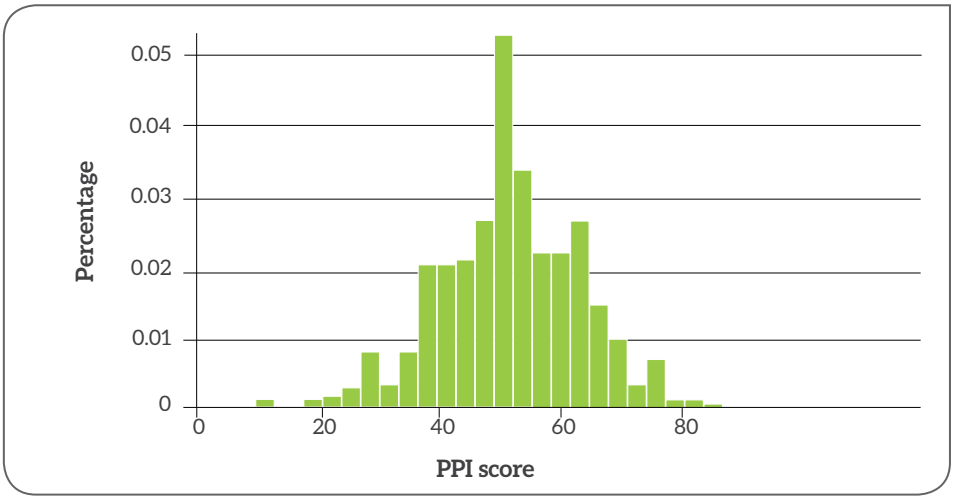


Figure 1: Progress out of poverty index (PPI) in rice households.

Source: Authors calculations from Gender/AWD survey (2016).

Economically, 96% of households confirmed that they depended primarily on the rice they produced. Even within agricultural areas, 99% said that rice was the most important crop for sustaining the household. Very few reported to have animals or other crops (Table 3). In some cases, at least for the principal plot, irrigated rice was rotated with corn, especially in Tolima (Figure 2). Only 18% had at least one household member with an off-farm occupation (excluding housewives and students). The households surveyed were basically rice producers and for them, this crop is their most important source of income.

Table 3: Ownership of animals and other crops.

Agricultural products	Ownership			Total
	Yes	No	No answer	
Animal				
Poultry	33.4	65.8	0.8	100
Pork	5.8	93.0	1.1	100
Cattle	13.7	83.6	2.7	100
Other animals	0.8	96.5	2.7	100
Crop				
Corn	18.6	81.4	0.0	100
Sugarcane	0.1	99.9	0.0	100
Banana	0.3	99.7	0.0	100
Cotton	2.0	98.0	0.0	100
Bean	0.6	99.4	0.0	100
Soybean	0.5	99.5	0.0	100
Cocoa	0.4	99.6	0.0	100
Forages	0.8	99.2	0.0	100
Pineapple	0.1	99.9	0.0	100
Home garden	0.2	99.9	0.0	100
Citrus	0.1	99.9	0.0	100

Source: Authors calculations from Gender/AWD survey (2016).

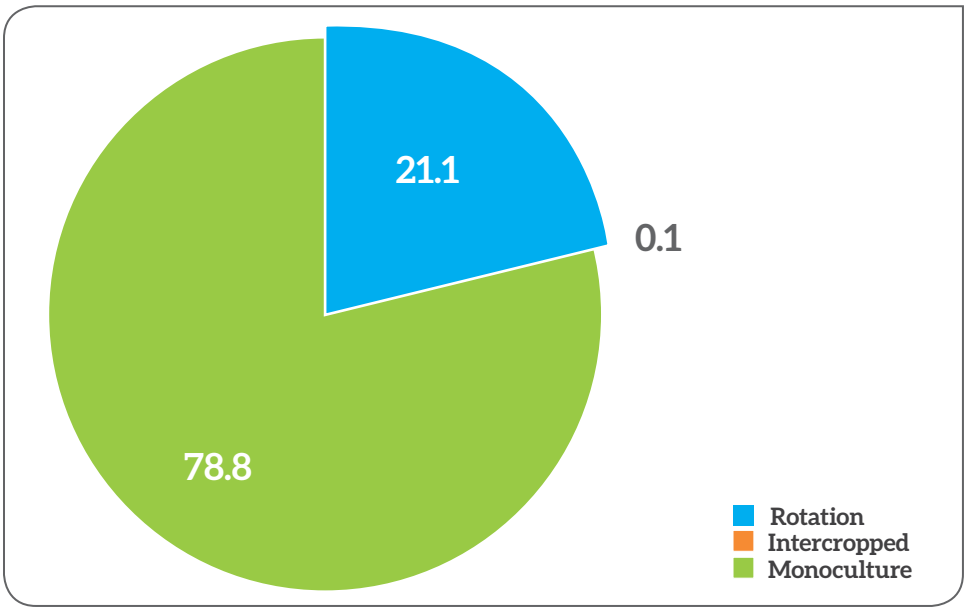


Figure 2: Type of rice system in the principal plot.

Source: Authors calculations from Gender/AWD survey (2016).

More than half of the households (59%) had only one plot for agricultural activities. The remaining cases had between 2 and 10 plots. Thus, on average, households had 2 plots for agricultural use (standard deviation: 0.07). Most of the plots were for irrigated rice (on average, 98% of the plots used by the household for agriculture were for rice). The maximum area of the biggest plot in the rice fields within a household was mostly below 17 ha. The results show that an important proportion, 27% had 3 ha or less, followed by 21% who had between 3 to 6 ha, 20% had between 6 and 9 ha, 17% had between 9 and 16 ha and the remaining had 17 ha or more.[1] The smallest plot size reported was 0.5 ha and the largest was 120 ha (Figure 3). From these plots of irrigated rice, the project characterized the most important plot, with an average yield of 6.0 t/ha for the five departments in the study.

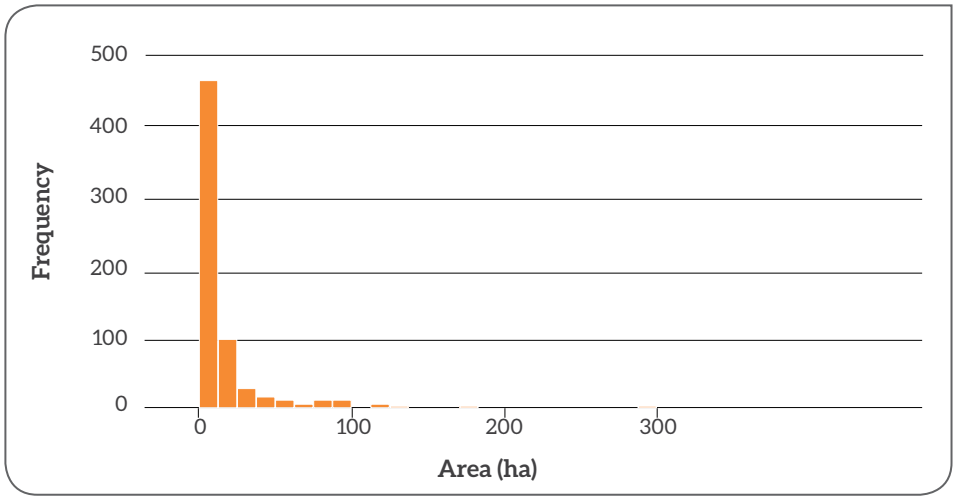


Figure 3: Number of hectares (ha) of the biggest plot of irrigated rice within the household.

Source: Authors calculations from Gender/AWD survey (2016).

1 These plots are the ones that were characterized in the surveys. In some cases, due to logistics, it was not possible to register all the plots of the households, because in some cases they exceed 100 plots.

About 99% of interviewed households sold 96% of their rice. The interviewed farmers stated that they mostly used FEDEARROZ 2000 (46% of the households) and FEDEARROZ 67 (33% of the households). The rest use FEDEARROZ 60 and Clear Field, among others.

Approximately half of the households reported that at least one household member belonged to an association or group. Interviewed farmers indicated that they trusted the advice and information they got from the National Federation of Rice Producers (FEDEARROZ) (52%), other agricultural associations (26%) and districts/ irrigation associations (19%). A similar proportion (52%) reported that at least one household member had received information on rice production and 53% had received information on water management. Most (92%) said they used the information received about production and slightly less (85%) used the information about water management.

3. Who makes the decisions in rice production?

Identifying who makes the decision about rice production is important for assessing whether a CSA practice will be implemented on a farm or not. "Programmatically, all those who are involved in making on-farm decisions should be targeted to maximize the chances that a program will be successful" (Twyman et al., 2015b). Within a household, it was possible to find more than one producer; the household head was not necessarily the only person who made decisions about the natural resources. Yet, in the case of farm-level production, not all decision makers were recognized as such, a situation that usually underestimates women's participation, including in the rice sector (FAO, 2007; Twyman et al., 2015 b).

According to the results, at least 38% of the households had more than one family member who was making decisions on or contributing to rice production.

However, women's participation was not recognized as much as men's. Women were recognized as principal rice producers only in 8% of the 609 cases, but the proportion of households in which they contributed as decision makers was higher (21%). This was identified by asking about the different activities in the decision-making process for rice production in which women were involved (Table 4). The variables in Table 4 were based on the theoretical proposals of Nalia Kabeer (1999, 2005). The decision-making process has two dimensions: the final action of the decision and the negotiations before this action. The present study operationalizes these dimensions by including questions about: who makes what decisions related to rice production (final decision); and who the final decision makers ask for advice (negotiations before action is taken).

Table 4: Key variables to identify participation in the decision-making process and assets ownership.[2]

Variables	Definition
Principal producer	Person in the household identified by the respondent as principal decision maker about rice production.
Recognition as producer	Family members that were recognized as producers by the respondent.
Final decision makers relating to agronomic activities	Family and others that participate in the final decision making about rice agronomic activities (e.g. seeding, fertilization, irrigation, weed control, etc.).
Final decision makers in relation to rice production	Family and others that make final decisions about rice production as principal producer, producer, or over agronomic activities (aggregated of the previous three variables).
Advisor on rice production	Family or others that give advice on the process of decision making.
Decision making in relation to rice income	Family or others that participate in final decision making or advise on income generated from rice production.
Rice plot owner (considered)	Person identified as the owner of the rice plots owned by the household.
Rice plot owner (documented)	Person listed on the documents as owner of the rice plots owned by the household.
Owner of productive assets	Person reported as owner of machinery and tools (e.g. tractor, combine harvester, scythe, etc.).

This chapter describes women's participation in rice production, their decision making in managing a rice plot and their contributions to productive assets.

3.1. Women's participation in decision making and ownership of productive assets

Women were identified as principal rice producers in about 8% of the cases, but when searching deeper in the activities carried out, it was found that the participation of women was higher. For each agronomic activity, the number of households that reported women's participation increased to 18%. Therefore, there were 21% of households in which women participated alone or with men in the final decision (see Table 5). This implies that for AWD, about a fifth of rice-producing households have women as decision makers too, and therefore their opinions should also be taken into account in the design and the possible dissemination of this technology.

Women's participation as advisors in the decision-making process is less than their reported participation – only by 6% of the cases (women and joint). This means that 23% of households had women participating in the process of decision making as principal producers, producers, final decision makers and/or advisors, either alone or with men (Table 6). Furthermore, women had an important contribution as landowners, as 32% of cases had their own plot for rice production (Table 5).

2 In order to see the questions on which this classification was based, see Annex 1.

Table 5: Women's and men's participation: Decision making and ownership of productive assets.

Type of participation	#HH***	Participation			Total
		Men	Women	Joint**	
Principal producer	609	91.7	7.6	0.7	100
Recognition as producer	605	88.6	6.3	5.1	100
Final DM*/ agronomic activities	609	81.7	0.6	17.8	100
Final DM*/ rice production	609	78.8	0.3	20.9	100
Advisor / rice production	467	93.6	1.0	5.4	100
DM / rice income	604	75.8	6.9	17.3	100
DM / rice production	609	77.2	0.0	22.3	100
Rice plot owner (consider)	380	68.1	11.6	20.3	100
Rice plot owner (documents)	324	68.3	12.2	19.5	100

Source: Authors calculations from Gender/AWD survey, 2016. * DM: Decision makers. **Joint: Both, women and men. *** HH: Household.

Table 5 presents three important aspects. First, although men participated in most of the households for each of the activities, women participated too, especially in the final decision making and as landowners. Second, when women participated it was more common that men participated too (i.e. the importance of joint decision-making). Third, depending on the research method, women's visibility increased or decreased; for example, when the question was about the main producer, the level of women's participation was less compared to when it was about the decision maker for each agronomic activity.

Table 6 shows the activities in which women had more contribution in the final decision making, alone or joint. Women were more likely to participate in "strategic" activities, such as which crop should be seeded, the planting date and how much of the production was for commercialization and how much was for other purposes (e.g. consumption of seed) (FAO, 2007; García, 2015). In the literature, there are some hypotheses for this type of phenomenon: through these activities women can control the land that they own as individuals or as part owners (Deere and Twyman, 2014; Twyman et al., 2015b); and/or the strategic decision was seen by household members as activities that had a direct impact on family income (García, 2015).

Table 6: Women's and men's participation in the final decision making about rice production, by activity.

Activity	#HH	Decision maker			Total
		Men	Women	Joint	
Crop to be seeded	609	87.5	5.2	7.3	100
Planting date	609	89.4	5.3	5.9	100
Variety	609	91.1	4.3	4.6	100
Land preparation	580	92.5	4.5	3.0	100
Irrigation	581	93.2	2.7	4.1	100
Transplanting	32	90.8	4.3	5.0	100
Direct seeding	522	93.5	3.1	3.4	100
Fertilization	597	92.3	2.7	5.0	100
Chemical weed control	592	92.9	2.8	4.3	100
Manual weed control	371	91.8	4.6	3.6	100
Pest/disease control	557	92.9	2.7	4.4	100
Harvest	601	92.5	4.5	3.0	100
How much to sell	606	87.7	6.5	5.8	100
Intermittent irrigation	85	92.2	7.8	0.0	100
Use of masive technology	120	90.9	9.2	0.0	100
Likely use of AWD	609	92.2	7.8	0.0	100

Source: Authors calculations from Gender/AWD survey, 2016.

Women participated less in the process *before* the final decision was taken – by giving advice or negotiating – than at the final decision making. Between 26% and 66% of the respondents reported that the decision makers trusted their own experience. This varies depending on their agronomic activity; in manual weed control and harvest, the percentage of respondents that believed in their own experience was higher compared with decisions about fertilization, chemical weed control and pest/diseases control. In the latter, they indicated that they sought advice mainly from FEDEARROZ (National Federation of Rice Producers) or other shops that sold agricultural inputs (Annex 1). Basically, in activities such as transplanting and harvest, women participated a little more (Table 7).[3]

3 It should be noted that most of the respondents were men so they could be underestimating the advice given by women.

Table 7: Women's and men's participation as advisors in decision making about rice production, by activity.

Activity	#HH	Participation			Total
		Men	Women	Joint	
Land preparation	241	94.6	4.9	0.5	100
Irrigation	241	94.9	5.0	0.1	100
Transplanting	11	90.0	0.0	10.0	100
Direct seeding	209	96.5	2.7	0.8	100
Fertilization	385	95.7	3.8	0.5	100
Chemical weed control	376	94.5	4.5	1.1	100
Manual weed control	133	98.3	0.4	1.3	100
Pest/disease control	364	96.7	2.9	0.4	100
Harvest	176	92.0	7.2	0.8	100
Recognition as advisor	37	100.0	0.0	0.0	100

Source: Authors calculations from Gender/AWD survey (2016).

3.2 Are women unrecognized in rice production?

To synthesize women's contribution to decision making and ownership in rice production, a conceptual operationalization was made for 'producer' or 'farmer' (considering the household's members). The variable was based on the following definition made by the Colombian National Agricultural Census of 2014: a producer is "a natural person or a group of people that make decisions over the activities related with the agricultural production unit and that affront the risk, take the credits, receive the earnings or assume the economic losses with their assets" (DANE, 2016). Based on this definition we include the following three domains to define rice producer/farmer: decision making about rice production, decision making about rice income and ownership of important rice productive assets such as land and machinery.

It was found that 34% of the households had women producers according to the above definition, although only 9% were interviewed and 8% were recognized as principal producers (Table 8). Also, the invisibility of women was seen in terms of access to agricultural information and participation in groups, as shown in Table 9.

Table 8: Gender of household head, interviewees and producers.

Gender of producers	Households			Total
	Men	Woman	Joint	
Household head	92.1	8.0	0.0	100
Interviewee	91.4	8.6	0.0	100
Producer (operationalization)	65.8	4.0	30.3	100

Source: Authors calculations from Gender/AWD survey (2016). n= 609.

Table 9: Households in which women and men received agricultural information and participated in groups.

Service /membership	#HH	Access and participation			Total
		Men	Woman	Joint	
Water information	339	87.9	6.6	5.6	100
Production information	287	88.0	5.7	6.4	100
Participation in groups	230	86.5	7.7	5.9	100

Source: Authors calculations from Gender/AWD survey (2016).

Table 8 shows the lack of recognition of women as rice producers. There are cases in which women are rice producers, but are not recognized as such. From the household in which women are rice farmers, about 31% of the cases were recognized (head of the household, principal producers, interviewed, receive information and had group membership). Answering the question, yes, there were unrecognized women in rice production: women that made decisions and contributed with productive assets, but were not considered (at least by the respondent) to be the household head, principal producer or an appropriate respondent, nor did they receive agricultural information or participate as group members.

3.3 Who are the unrecognized women in rice production?

This section analyzes the information at the level of the individual (as opposed to household-level analysis made in the preceding paragraphs). It was found that the proportion of unrecognized women rice producers was greater than in the case of men. Although there were 250 women producers, just 51 of them were considered to be principal producers,[4] a similar number to the household heads (47 women). Meanwhile, 675 men were producers and 555 were recognized as rice farmers. Figure 4 demonstrates that most women who made decisions about rice production were not recognized, an aspect that could interfere with other types of interventions too (e.g. technology dissemination and adoption). Also, it shows the inequality in the access to important services, such as information related to the use of water and/or production, and group membership. Most of the rice-producing women (73%) – compared to just 12% of men – did not get any recognition as principal producers or respondents, and did not have access to information and groups.

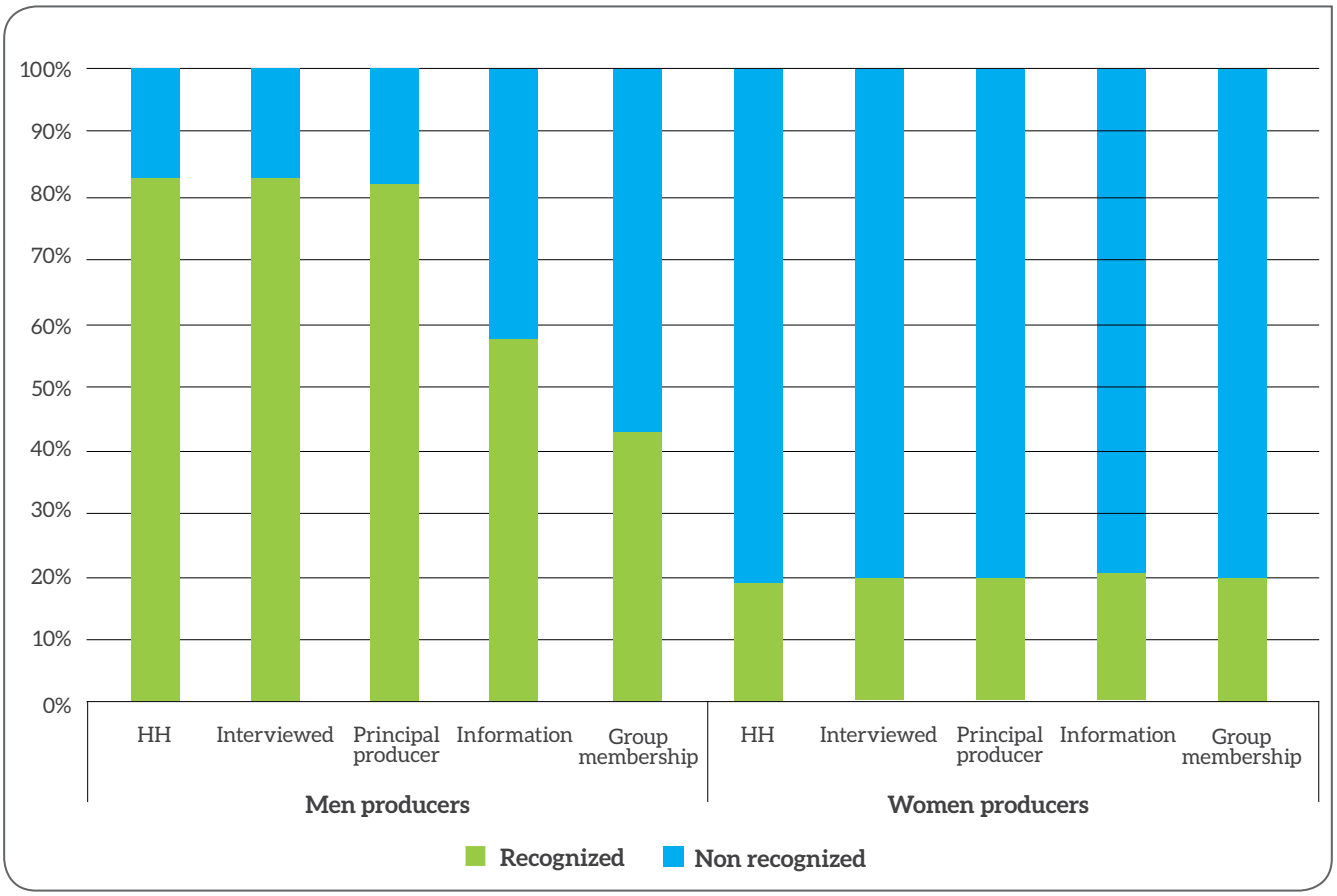


Figure 4: Percentage of women and men producers, recognized as household heads interviewed, principal producer, target of information services and group membership.

Source: Authors calculations from Gender/AWD survey (2016). # of men producers = 675; # of women producers = 250.

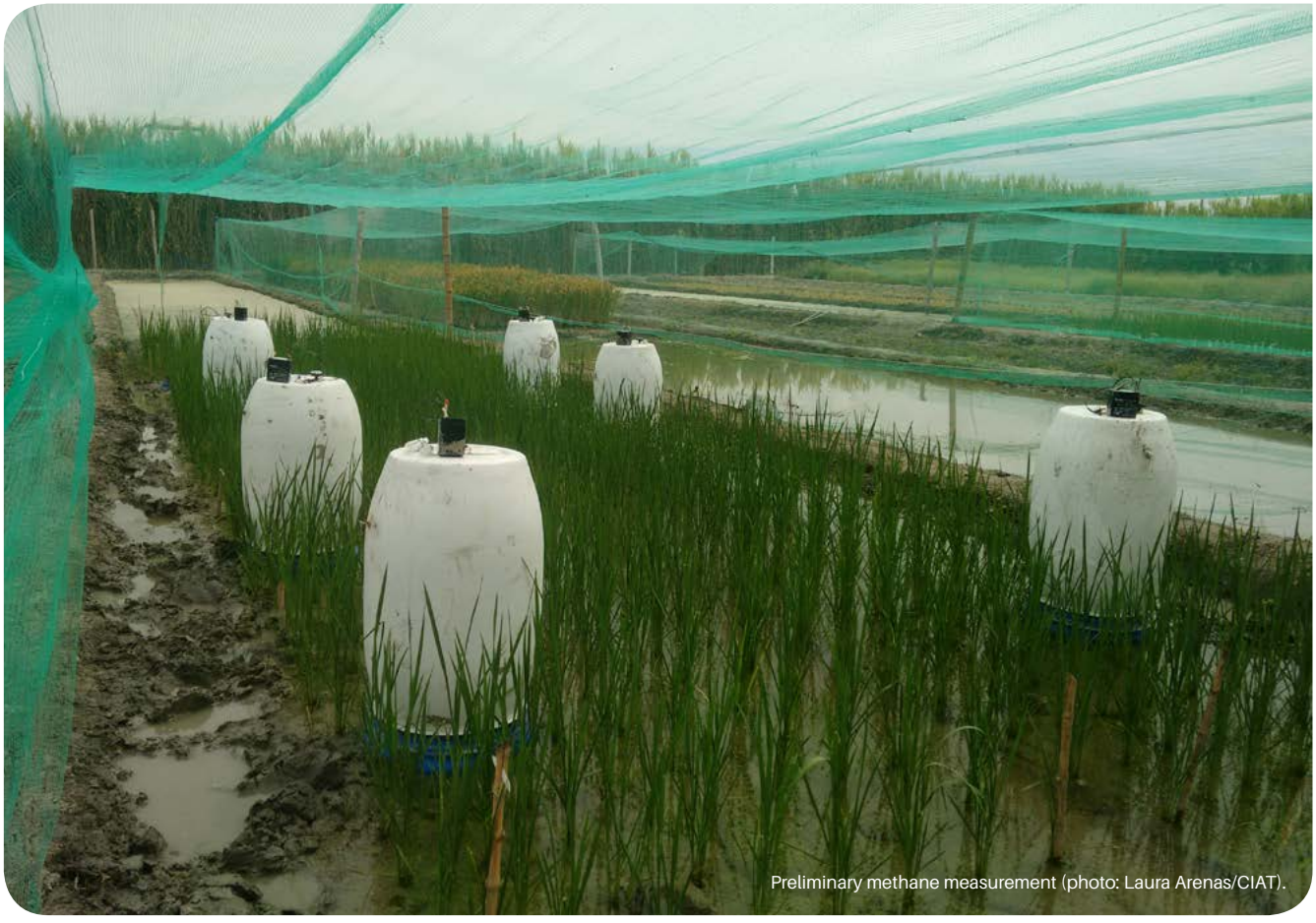
4 The definition of producer is based on the Colombian National Agricultural Census.

The unrecognized women rice producers were concentrated in male-headed households where they were mainly performing domestic chores. Most of these women (83%) were married or in a consensual union; 75% were housewives and dedicated a lot of their time to domestic activities – on average 14 hours per week.

Also, these women were concentrated in households in Tolima, Norte de Santander, and Casanare. Specifically, of the total households with women rice producers in Tolima, Norte Santander, and Casanare, women were considered to be unrecognized in 66, 70 and 59% of cases. These households were more likely to be below the poverty line, with 18% of probability compared to 8% probability for households in which they were recognized, according to the PPI. They were concentrated in households with the following characteristics: the maximum of irrigated rice plots was slightly higher, at 12 ha, compared to those cases in which they were recognized; on average the person who had the most experience in rice production in the household was 23.2 years old, 4.2 years more than in households where women were visible as producers. In other words, women that were unrecognized were those that were seen as responsible for the household; they were spouses and housewives in male-headed households with a higher risk of being below the poverty line.

3.4 Including women in the dissemination of CSA technologies

Women should be targeted in the process of dissemination and implementation of CSA technologies because they participate in the decision-making processes of rice production and they contribute to it with productive assets; they make up approximately a third of the population of the study. The main problem is that a significant proportion of these women are unrecognized. They are unrecognized as rice farmers in various spheres, including access to information and services. Gender differences can affect the implementation of AWD, as women play an important role in rice production, but these roles are often not recognized. If Colombia does not consider women and their roles in rice production when/if they promote AWD, adoption rates may be lower than expected.



Preliminary methane measurement (photo: Laura Arenas/CIAT).

4. Gender differences in access to the key resources/incentives for AWD

A second way to respond to the question of how gender differences could affect the implementation of AWD is by understanding the dissimilarities between households in which women participation in rice production and those in which women do not participate, especially in terms of their access to important resources and perceptions of incentives for AWD. In some Asian countries, such as Bangladesh and the Philippines, evaluation studies have shown how access to water, level ground, level of education of the farmer and payment for water are important resources and incentives that can enable or limit the implementation of AWD (Adhya et al., 2014; Lampayan et al., 2015; Rahman and Bulbul, 2015).

The survey questionnaire included the above variables. In this document, we analyze five of them. In future analyses we will integrate more variables and more robustly analyze the ones presented here. Households were identified that had the following attributes: economic incentives to reduce the use of water; noneconomic incentives to use AWD; level ground; water availability; control of water; membership of irrigation district or water associations; and access to agricultural information related to water and rice production. Table 10 is a summary of the operationalization developed to construct the variables mentioned and the potential aspects to be integrated in future analyses.

Table 10: Operationalization of key resources or incentives in order to use AWD.

Variables	Definition for this document	Potential aspects to be integrated (further analysis)
Economic incentives	Households that pay for water by volume.	Inputs, pumping and labor.
Non-economic incentives	Households that identify water reduction and mitigation of climate change as the main reasons for using AWD rather than increased yields and reduced costs).	-
Level ground	Households that affirmed to have carried out land leveling once in the principal rice plot.	Ground without hollows or gaps that permit better water management (from the farmer's perspective).
Water availability	Qualifies with a 4 or 5 (from 1 to 5) the access of water.	-
Control of water	Households that identified 100% control of water for rice irrigation or who could control but needed to ask third parties in order to use it.	-
Irrigated district/water association membership	Households in which at least one household member was part of an irrigated district or water association.	-
Access to rice production and water information	Households in which at least one household member had access to information about rice production or water use.	-

Source: Authors' design (2016).

In general, the households interviewed did not present economic incentives (at least in terms of paying for water by volume) or noneconomic incentives (e.g. mitigation and saving water). The majority reported that they performed land leveling in the principal rice plot at least once; but it was not possible to determine if the plots were well levelled. More than 50% had at some time experienced problems with water availability, but more than 90% reported that they had control over this natural resource when was available. A total of 40% belonged to an irrigation district and/or water association and 60% had access to water and/or production information (Figure 5).

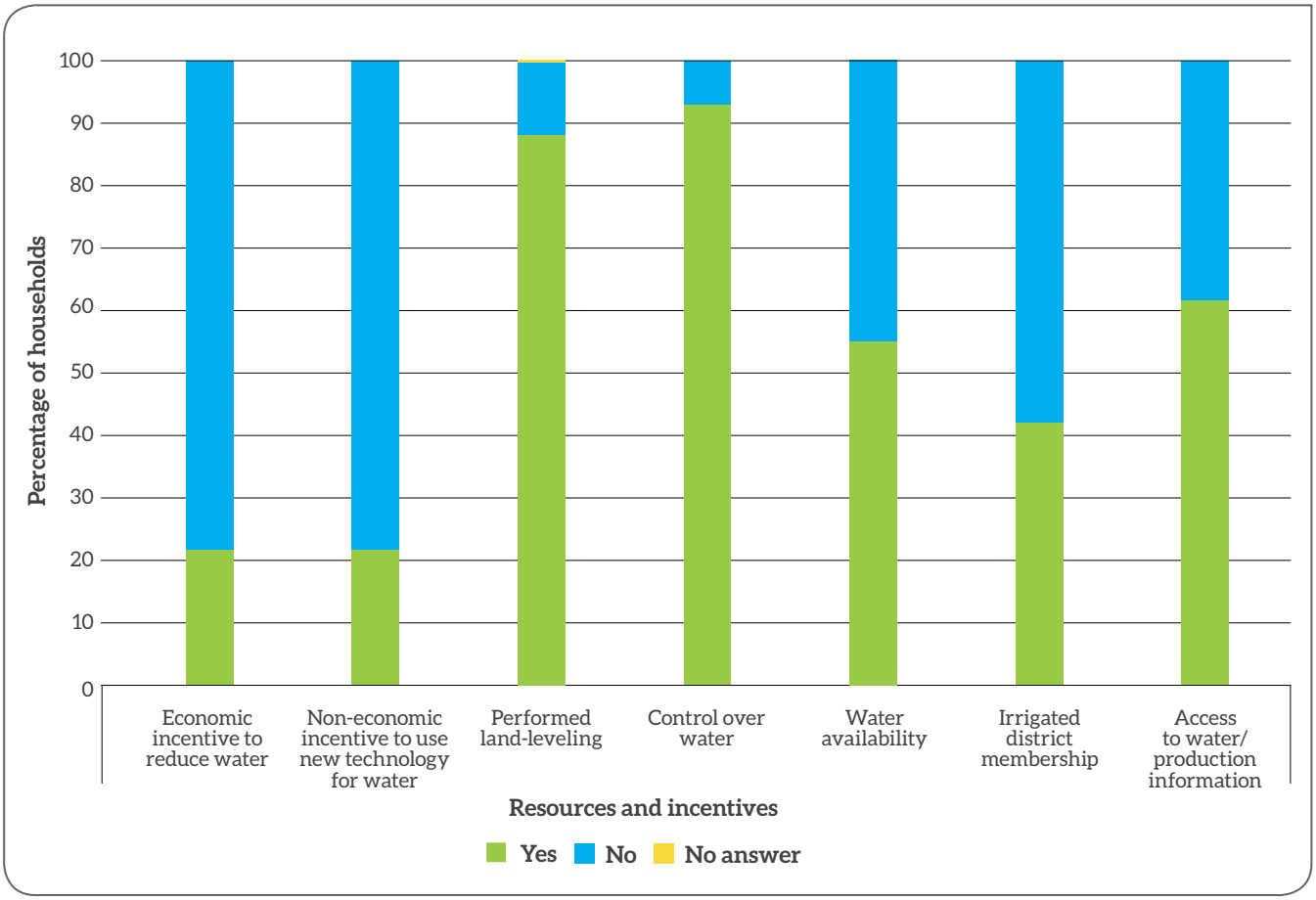


Figure 5: Key resources and incentives to implement AWD.
Source: Authors calculations from Gender/AWD survey (2016). # = 609.

In general, rice producers do not have incentives to reduce water use. In most cases, water payments were made per hectare rather than based on the volume of water used. Therefore, for farmers, water saving generally did not negatively affect the amount of money they spent on water. Furthermore, irrigation was an activity that was just a small part of total production costs. The questionnaire asked respondents to rank four elements of production – irrigation, weed control, land preparation and fertilization – from the costliest activity to the cheapest. Irrigation was usually located in the third or fourth place. And the cost of water was not identified as a problem in the production cycle (1% of households). This issue was confirmed with some semi-structured interviews conducted in districts and water associations in Tolima, Norte de Santander and Córdoba; these interviews confirmed that farmers did not have incentives to use less water and that they, as districts, did not have the capacity to charge by volume.[5]

While water associations and irrigation districts did not have the capacity to fully regulate or charge for water, there were still times when water was quite scarce in this region. It was also found that most households (more than 90%) had control over the water on their farm. As stated by several respondents, water availability is a huge challenge for rice producers. From the producer's point of view, about 98% of households used rivers as their main source of water for irrigation and 59% identified that sometimes there was not enough water in the rivers.

The access to key resources for implementation of AWD varied by department. Differences were found, especially in noneconomic incentives, economic incentives and land leveling. In fact, Norte de Santander was the department where the greatest proportion of rice households had the key resources necessary for AWD adoption (Figure 6).

5 Gabriel LaHue, PhD student from the University of California, Davis, used semi-structured interviews in irrigated districts and water associations as part of the studies in AWD that CIAT is leading in Colombia.

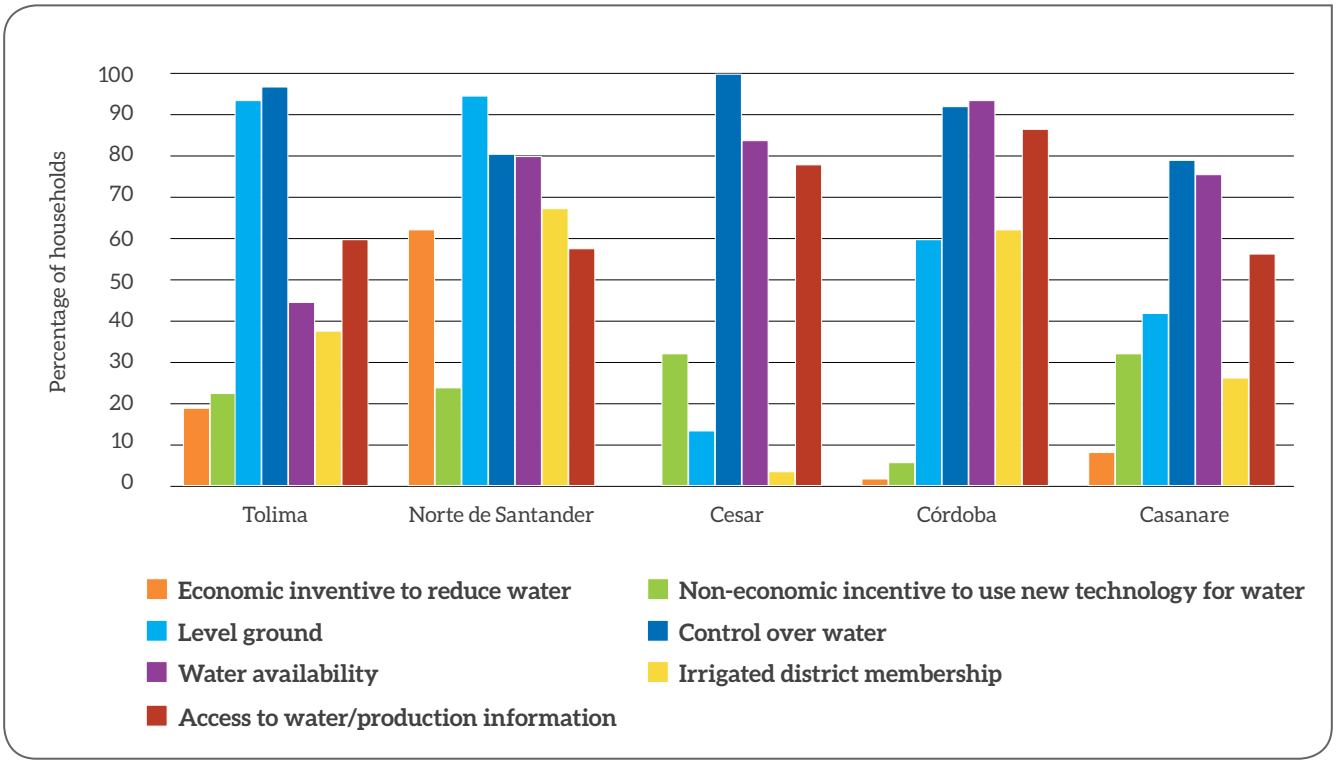


Figure 6: Differences in access to key resources to implement AWD by departments.

Source: Authors calculations from Gender/AWD survey (2016).

In Norte de Santander, approximately 60% of the households had an economic incentive to adopt AWD, contrary to other departments where incentives were calculated at less than 20%. In Norte de Santander, there is a larger proportion of households that pay for water based on the volume of water used, rather than on the cultivated area or season. Noneconomic incentives seem to be more relevant in Casanare and Cesar, and less in Córdoba. Apart from Cesar and Casanare, more than half of the cases in each department confirmed that they had carried out land leveling at least once. Control of water or water availability did not seem to be a problem for any of the departments but water availability was more of an issue for Tolima. Nonetheless, in Norte de Santander, Cesar and Casanare, the water availability problem was reported in approximately 20% of the cases. Casanare and Cesar are departments in which a greater proportion of households did not have access to irrigation district or water association membership. And access to information was higher in Cesar and Córdoba.

Overall, Tolima had a substantially higher proportion of cases with level ground, control over water and access to water/production information. Norte de Santander had the majority of resources and economic incentives. Farmers in Córdoba did not have economic and noneconomic incentives to adopt AWD, and those in Casanare had a higher level of noneconomic incentives than in the other departments.

4.1 Resources/incentives for AWD by gender

After describing the overall situation of households' access to, and control over, resources and their incentives for water management, Figure 6 disaggregates the key resources and incentives by gender, using an approximation that combines the participation of women in the field and the gender of the household head to construct various variables available to agricultural studies for operationalizing the gender of the producer. So we combined the gender of who decides and contributes resources to rice production with the head of the household. Therefore, here households were classified into three categories: male-headed households with no women producers; male-headed households with women producers; and female-headed households with women producers.

The resources and incentives were disaggregated among the three types of households. We observed statistical differences in water availability, noneconomic incentives and access to information (Figure 7). Female-headed households with women producers were more likely to have water availability compared to the other two cases and more access to information and noneconomic incentives. In addition, male-headed households, with women producers, were more likely to have this resource and incentives. On the other hand, male-headed households, with no women as producers, are likely to have lower non-economic incentives.

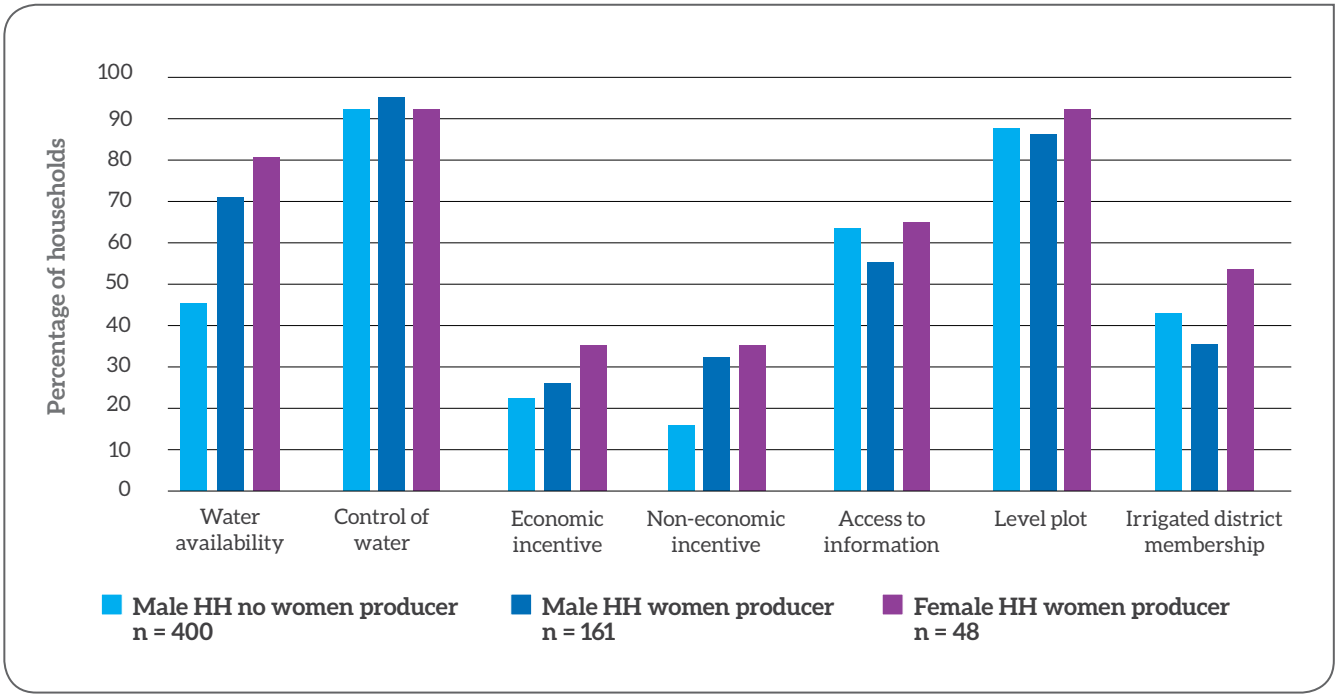


Figure 7: Differences in access to key resources to implement AWD between types of households (household head-women producer).
Source: Authors calculations from Gender/AWD survey (2016).

Various hypotheses could explain this; here we explore one. Households with women who participated as rice producers may have experienced better water availability because they were in places that did not suffer water scarcity as much as in other places. As Figure 8 shows, women's participation was more visible in Norte de Santander and Casanare, two departments in which water availability is not a problem for the majority. But further analyses must be carried out to have a better understanding of the situation.

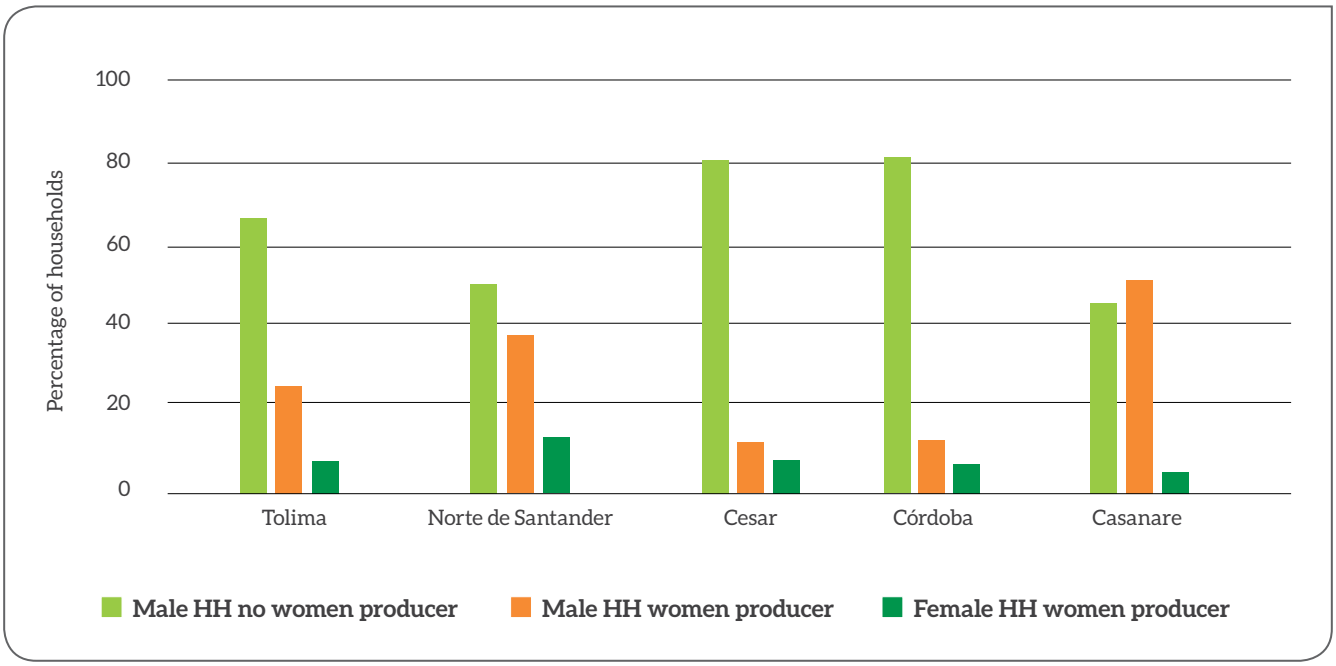


Figure 8: Women participation by types of households and department.

4.2 Women are more likely to have non-economic incentives for awd

According to the results described here, there is a second reason to include women in a program to increase implementation of AWD in Colombia. Households in which women participate as producers – in male- or female-headed households – are more likely to have noneconomic incentives. This is because these households prefer mitigation and water saving rather than productivity increases or a reduction in costs as potential motivating factors in implementing AWD. Also, households with women producers were more likely to have water availability, which is a key factor for the implementation of this technology, in part because women's participation is more visible in Tolima and Norte de Santander that have less problems of water availability compared to other departments.

5. Possible effects of AWD in gendered labor activities

Developing and disseminating technologies that are implemented by farmers requires a critical analysis of possible social effects that this might have on the population of intervention. One such social effect is on labor use in the production process, specifically in those activities that could be affected by AWD implementation, such as irrigation and weed control. AWD is likely to impact irrigation and may increase weed pressure if it is not well managed depending the previous water management and weed control techniques. Specifically, change in water management, could potentially affect: the timing and frequency of weed control, and/or the intensity of effort needed for weed control. Many agricultural technologies are considered to be labor saving, in other words, "tools and equipment which reduce drudgery and/or improve efficiency of performing various farming or household activities" (Bishop-Sambrook, 2003). It is also important to note, that labor-saving associated with technologies such as AWD could also reduce employment opportunities and, consequently, income for hired labor.

Apart from decision making, women also participate in activities related to irrigated rice production. Men participate in almost all the agronomic activities as both family and hired labor; women participate mostly as family labor (Table 11).

Table 11: Percentage of HH in which women and men participate in labor rice activities.

Type of participation	#HH	Labor	
		Men	Women
Family labor	599	96.4	63.9
Hired labor	604	100.0	31.6
Labor (family and hired)	609	100.0	74.9

Source: Authors calculations from Gender/AWD survey (2016).

As presented in Tables 12 and 13, in nearly all households, men participated in activities related to the production process. Women contributed to specific activities that were more manual or not "directly" related to agronomic activities. As family labor, women were more likely to participate in food provision, supportive tasks, registration of information, or as family labor providers (as an overall without a specific activity)[6] (Table 12). As hired labor, their participation was in these activities as well as in manual weed control and transplanting (Table 13). Labor time in weed control could change with the implementation of AWD, requiring more or fewer person days during the rice production cycle.

Table 12: HH where women and men participate in family labor for each activity.

Type of participation	#HH	Family labor	
		Men	Women
Family labor (recognition)	90	55.7	61.6
Soil preparation	158	98.5	3.3
Irrigation	269	100.0	3.9
Transplanting	18	100.0	5.4
Direct seeding	187	99.0	3.6
Fertilization	246	99.5	2.9
Chemical weed control	197	99.3	1.6
Manual weed control	111	100.0	2.7
Pest and diseases control	182	99.9	2.2
Harvest	268	98.0	5.5
Supervision	386	95.1	8.8
Food provider /cooking	166	61.9	49.7
Registration of information	313	90.9	13.1
Sale	568	93.9	10.0
Support (eg. buy inputs)	89	69.2	38.9

Source: Authors calculations from Gender/AWD survey (2016).

6 The last variable refers to the following question asked at the beginning of the questionnaire for each of the household's members: Does the household member [*name of the person*], participate in rice production such as family labor? This variable is different in methodological terms from the other questions about labor as it seeks for a first recognition of the family members as labor force in the rice plot.

Table 13: HH where women and men participate in hired labor for each agronomic activity.

Activity	#HH	Hired Labor	
		Men	Women
Soil preparation	551	100.0	0.3
Irrigation	445	100.0	1.2
Transplanting	29	100.0	50.5
Direct seeding	448	100.0	1.0
Fertilization	551	100.0	1.1
Chemical weed control	554	100.0	0.8
Manual weed control	342	83.4	21.0
Pest and disease control	529	100.0	0.6
Harvest	585	100.0	1.5
Supervision	119	100.0	4.0
Information registration	75	91.4	11.3
Food provider /cooking	132	30.2	78.9
Sale	45	98.7	1.3

Source: Authors calculations from Gender/AWD survey (2016).

AWD could affect labor time; therefore it could have a positive or a negative effect on the laborers' lives, as Farnworth (2015) mentioned in the case of Asia. It could reduce the time used in the rice plot for those who worked as family labor in activities such as weed control and irrigation. But at the same time, it could reduce the hired labor required for these activities. Table 14 shows the person days used for each activity by gender according to who performed it. Results show that irrigation and manual weed control were the two activities that required the most person days.

Table 14: Person/days for each agronomic activity by gender.

Activity	#HH	Family			Hired			Total family-hired		
		Men	Women	Total	Men	Women	Total	Men	Women	Total
Soil preparation	545	0.8	0.0	0.8	2.0	0.0	2.0	2.8	0.0	2.8
Irrigation	535	16.6	0.1	16.8	22.5	0.0	22.5	39.1	0.2	39.3
Transplanting	31	1.1	0.0	1.1	3.6	0.9	4.5	4.7	0.9	5.6
Direct seeding	482	0.2	0.0	0.2	0.8	0.0	0.8	0.9	0.0	1.0
Fertilization	578	1.0	0.0	1.0	3.0	0.1	3.1	4.0	0.1	4.1
Chemical weed control	576	0.5	0.0	0.6	2.1	0.0	2.1	2.6	0.0	2.6
Manual weed control	403	1.6	0.0	1.7	5.8	1.3	7.1	7.4	1.4	8.7
Pest and disease control	541	0.8	0.0	0.8	1.4	0.0	1.4	2.2	0.0	2.2
Harvest	576	0.4	0.0	0.4	1.5	0.0	1.5	1.8	0.0	1.9

The information currently available is the number of person days used for each agronomic activity and the number of households that used labor for a specific activity. But there is no information on how AWD might have affected the time used for irrigation and/or weed control. In a scenario in which AWD increased the person days required for manual weed control, rural women who worked as paid labor (or men) would in theory have more opportunities to generate income. But, if the person days needed for this kind of labor are reduced, women would have less paid work – an issue that could translate into less income for rural households. The same case has been mentioned for conservation agriculture (Beuchelt and Badstue, 2013).

Therefore, it is important to systematize information in terms of labor force used in the scenario of AWD, to compare the possible impact that this technology may have had on the number of person days used, and thus on the lives of those women and men who work in weed control and irrigation (e.g. systematized information from experimental plots for AWD or apply a randomized controlled trial [RCT] methodology).

Photo: Laura Arenas/CIAT.

6. Concluding remarks and recommendations

According to these results, it is important to consider gender for disseminating technologies related to water management (i.e. AWD) in the Colombian rice sector, for the two main reasons outlined below.

- First, in pragmatic terms, it is important to include women rice producers during field experimentation and dissemination of this technology in order to contribute to a higher rate of adoption. As highlighted here, women participate in the decision-making process and contribute their assets. The main producer is not the only one making decisions about rice production, and in some cases, those who make the decisions get advice from others, including from national agricultural associations and inputs sellers. Therefore, it is important to consider all these actors when designing dissemination approaches for strategies such as AWD. Also, as households where women participated in rice production were more aware of the mitigation and water-saving benefits of AWD, targeting such households could increase early adoption rates.
- Second, in terms of social justice, even when women participated, they did not receive recognition of being rice producers; they did not get access to information of rice production or group membership in the same numbers as men did. The dissemination of new technologies in rice production could be an opportunity to involve more women in this process, and increase their access to agricultural services. Also, AWD may affect the time used for labor related to irrigation and weed control activities. Women worked in manual weed control as hired labor and men worked in irrigation and chemical weed control. Therefore, it is important to be aware of this issue when developing an implementation, strategy for AWD and designing alternatives to mitigate the negative effects on the livelihoods of those women and men, or support the possible positive effects.

According to these main results the following steps are recommended (Figure 9):

1. Integrate a gender perspective in the future research and implementation of AWD in Colombia.
2. Include social trade-offs (i.e. economic, productive, climatic and agronomic) in the analyses conducted on the implementation of AWD.
3. Share the information with scientists and national stakeholders working in rice production. This can include blog posts, info notes, and other briefs – for example a blog post was written to share the study of gender and AWD.[7]

7 To read the blog, enter the following link: http://blog.ciat.cgiar.org/gender-and-awd-a-study-in-progress-with-rice-farmers-in-colombia/

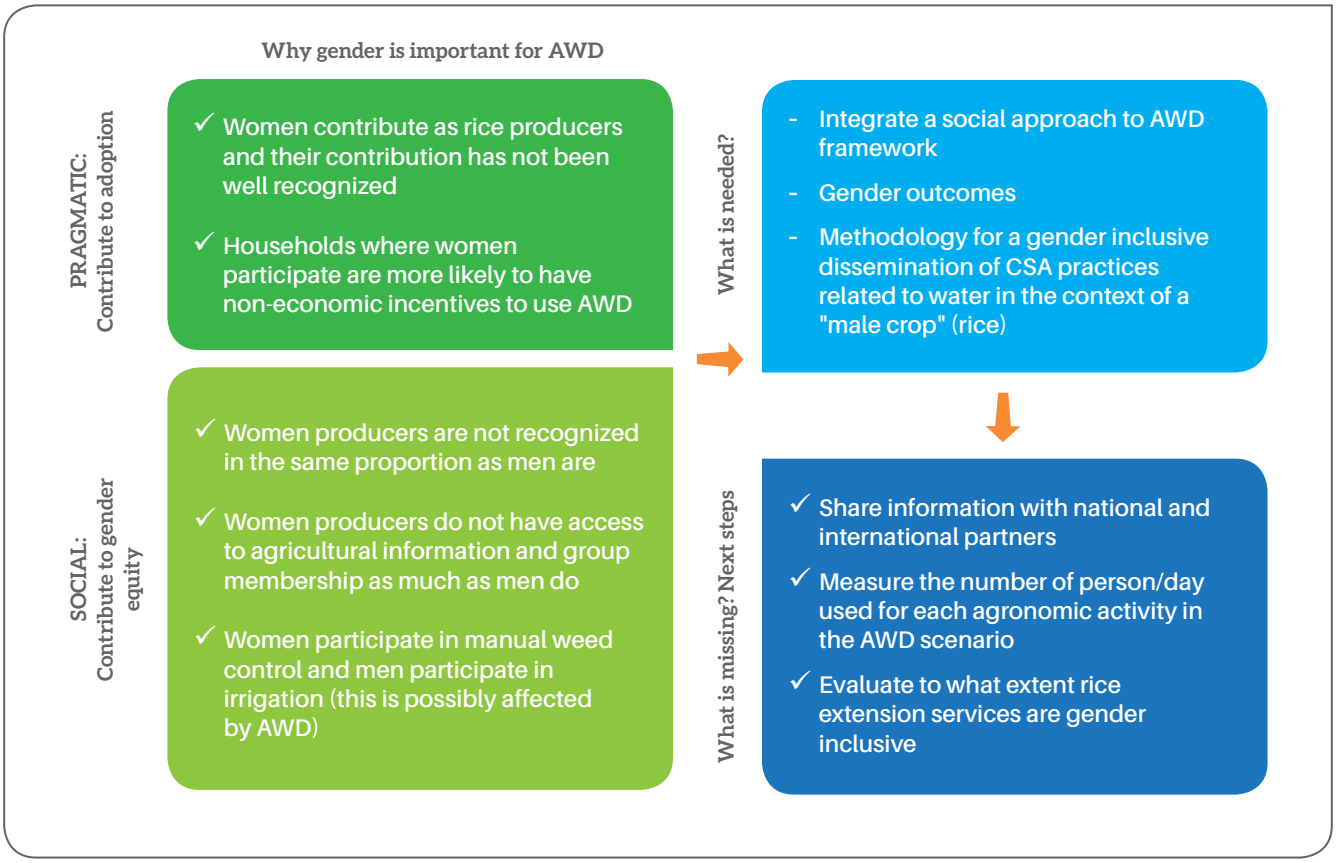


Figure 9: Concluding remarks and next steps.

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Annex 1

Table A. Questions used for the classification of Tables 4 and 5.

Variables	Questions in English	Original questions in Spanish
Principal producer	Who is the person that makes the principal decisions over the use of the resources and has control over the production?	*¿Quién es la persona que toma las decisiones principales sobre el uso de recursos y ejerce el control de la producción?*
Recognition as producer	The household member [name of the person], participates in rice production as: - Principal producer that makes decisions.	*El miembro del hogar [nombre de la persona], participa en la producción de arroz como:* *- Productor principal tomador de decisiones.*
Final decision makers re agronomic activities	Who made the decisions over [agronomic activity] (16 agronomic activities).	*¿Quiénes tomaron la decisión de [actividad agronómica]? (16 actividades agronómicas).*
Final decision makers re rice production	Aggregated the above three activities.	N/A
Advisor in rice production	Who are these people to whom you ask advice for [agronomic activity]? (10 agronomic activities).	*¿Quiénes son estas personas a quienes consulta o pide consejo [actividad agronómica]? (10 actividades agronómicas).*
Decision making re rice income	Who decides how to spend the income of the rice that is sold?	*¿Quiénes deciden cómo gastar los ingresos producto de la venta del arroz?*
Rice plot owner (considered)	Who in the household is considered the landowner of the plot?	*¿Quiénes en el hogar se consideran los dueños del lote?*
Rice plot owner (documented)	Who appears in the documents as the owner?	*¿Quiénes aparecen en el documento como los dueños?*
Owner of productive assets	Who are the owners of the assets [asset]? (8 productive assets).	*¿Quiénes son los dueños del [activo]? (8 activos productivos).*

Table B1: Source of advice for decision making about rice production by agronomic activity (percent HH).

Activity	#HH	Source of advice for decision making about rice production								
		No	Yes							
		Trust in own experience	FEDEARROZ	Input seller	Irrigation district	Other producer	HH member	Other related	Employee	Other
Land preparation	583	56.8	30.1	21.1	1.5	0.4	0.4	0.6	2.5	1.6
Irrigation	582	51.1	28.5	17.4	3.1	0.1	1.2	0.2	10.0	4.4
Transplanting	39	52.3	39.4	27.5	5.6	0.0	5.3	0.0	2.3	0.0
Direct seeding	525	53.1	29.6	24.3	1.5	0.1	0.0	0.7	2.3	1.4
Fertilization	599	26.8	38.0	41.2	1.6	2.0	1.3	0.3	2.2	1.5
Chemical weed control	595	28.1	38.2	39.5	2.0	2.2	0.9	0.8	1.8	1.3
Manual weed control	371	63.6	23.5	14.8	1.8	0.3	0.3	0.8	2.8	0.7
Pest and disease control	561	26.1	35.3	45.5	2.2	2.2	1.1	1.0	2.4	0.9
Harvest	603	65.9	23.7	17.9	1.5	0.1	0.4	0.6	1.6	0.5

Source: Authors calculations from Gender/AWD survey (2016).

Table B2: Ownership by gender of agricultural tools and machinery for rice.

Asset	#HH	Owners			Total
		Men	Women	Joint	
Reserve water	16	66.0	19.7	14.3	100
Tractor	147	94.4	3.8	1.8	100
Small agricultural tools	463	88.5	4.4	7.1	100
Handpump	360	91.7	5.3	3.0	100
Motorpump	132	93.3	5.3	1.4	100
Pipeline	48	91.6	5.1	3.4	100

Source: Authors calculations from Gender/AWD survey (2016).

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